Equilibrium Price Dynamics in Perishable Goods Markets: The Case of Secondary Markets for Major League Baseball Tickets

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Introduction

- aim: describe equilibrium pricing patterns and test theories of equilibrium pricing behavior in perishable goods markets
- event tickets are *perishable goods* with *fixed date consumption*
  - worthless once the game is played
  - cannot be consumed before the game is played

Revenue Management Models of Dynamic Pricing of Perishable Goods

- examples: McAfee and te Velde (2006), Gallego and van Ryzin (1994)
- basic theoretical structure:
  - seller starts with a given inventory and continuously varies price (no commitment)
  - consumers arrive randomly, purchase at once or exit
  - demand parameters constant over time
  - market ends (inventory perishes) on a fixed date
- optimal price depends on probability that a current sale prevents a future one because of a stock-out
  - lower inventory $\longrightarrow$ higher prices
  - less time remaining $\longrightarrow$ lower prices, as future selling opportunities disappear
- a "robust prediction" (McAfee and te Velde) is that expected prices should fall over time

Empirical Evidence and Motivation for Looking at Secondary Ticket Markets

- little empirical work testing these models
- when declining price prediction has been tested (e.g., airlines by McAfee and te Velde), it has been rejected. Why?
  - consumer demand changes over time
  - commitment
- secondary event ticket markets have several nice features:
  - sellers are small and fairly anonymous, so commitment incentives should be small
  - most sellers offering one unit (e.g., a pair of tix), so declining price prediction emerges unambiguously

What the Paper Does

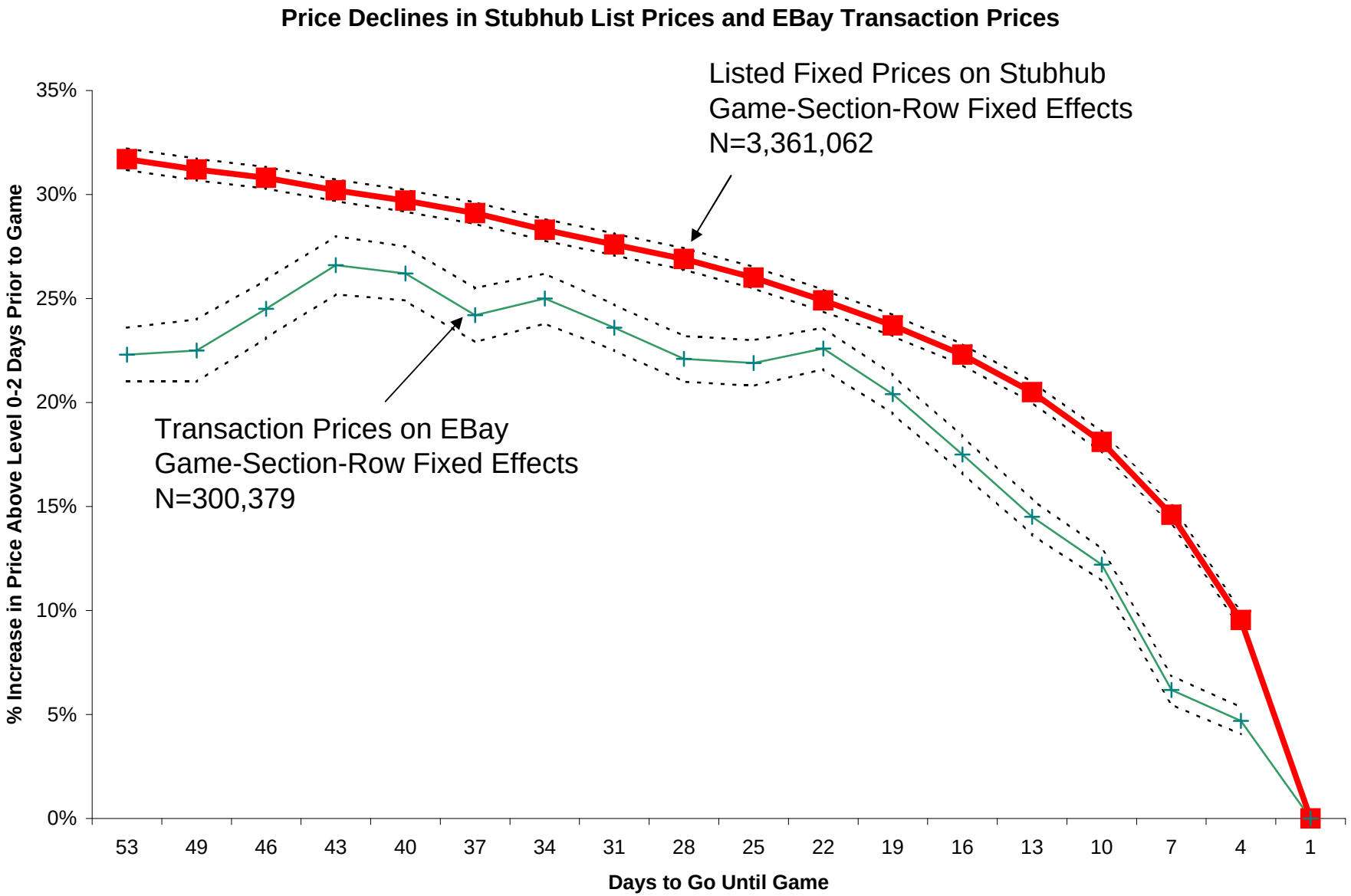
1. shows, using data from two large markets, that list and transaction prices decline by significant amounts (20-50%) as the game approaches
2. describes three theories for why prices decline:
    1. RM explanation
    2. residual demand becomes more elastic over time
    3. seller learning (e.g., Lazear (1986))
3. rejects 3 using reduced-form evidence; shows 1 preferred to 2 by estimating models of the seller's price-setting problem
4. show most observed early purchasing rationalized by plausible 'return to market'/search costs & risk-neutrality given product differentiation and uncertainties about availability of particular types of ticket

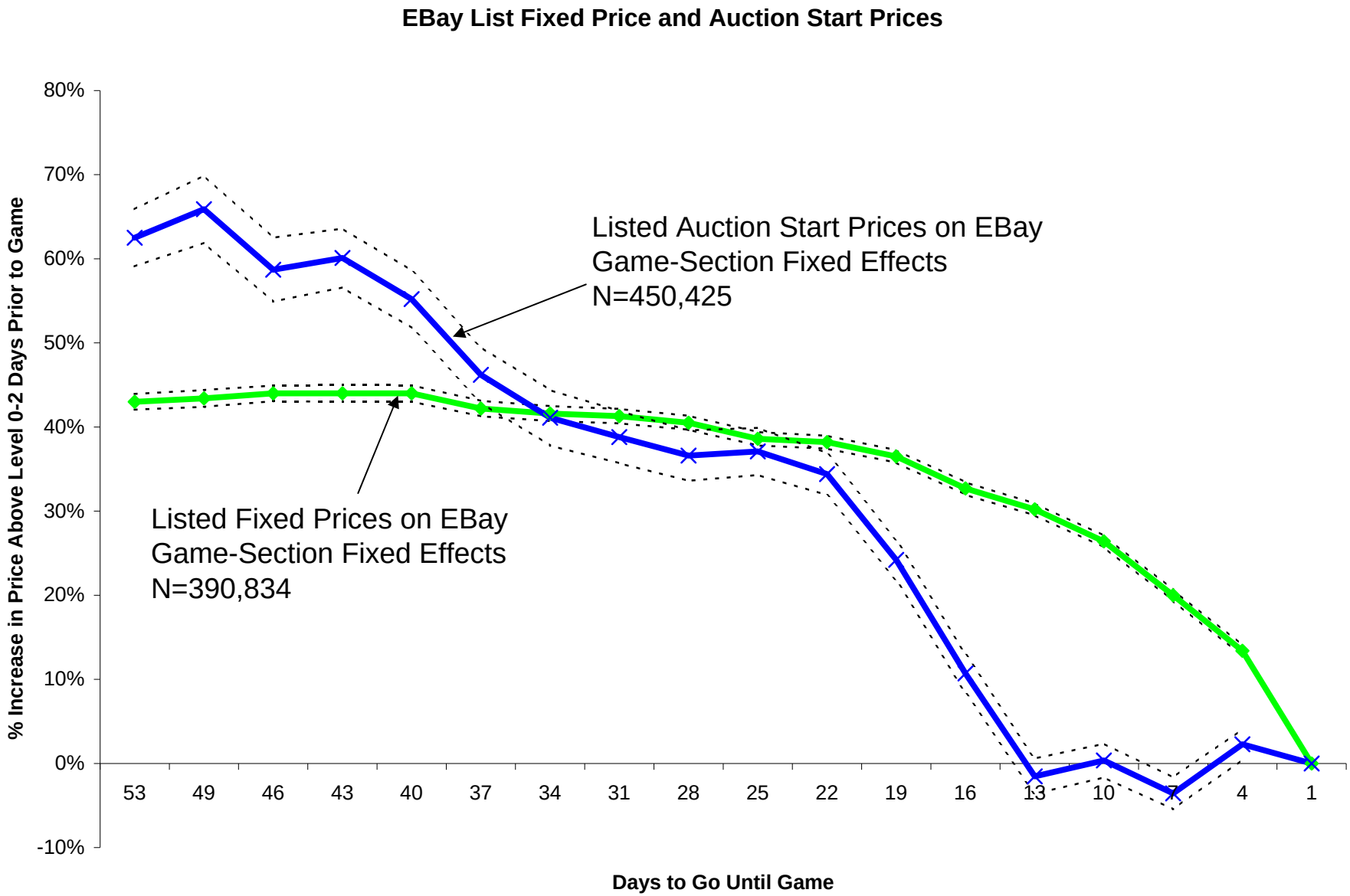
(Descriptive) Evidence of Price Declines

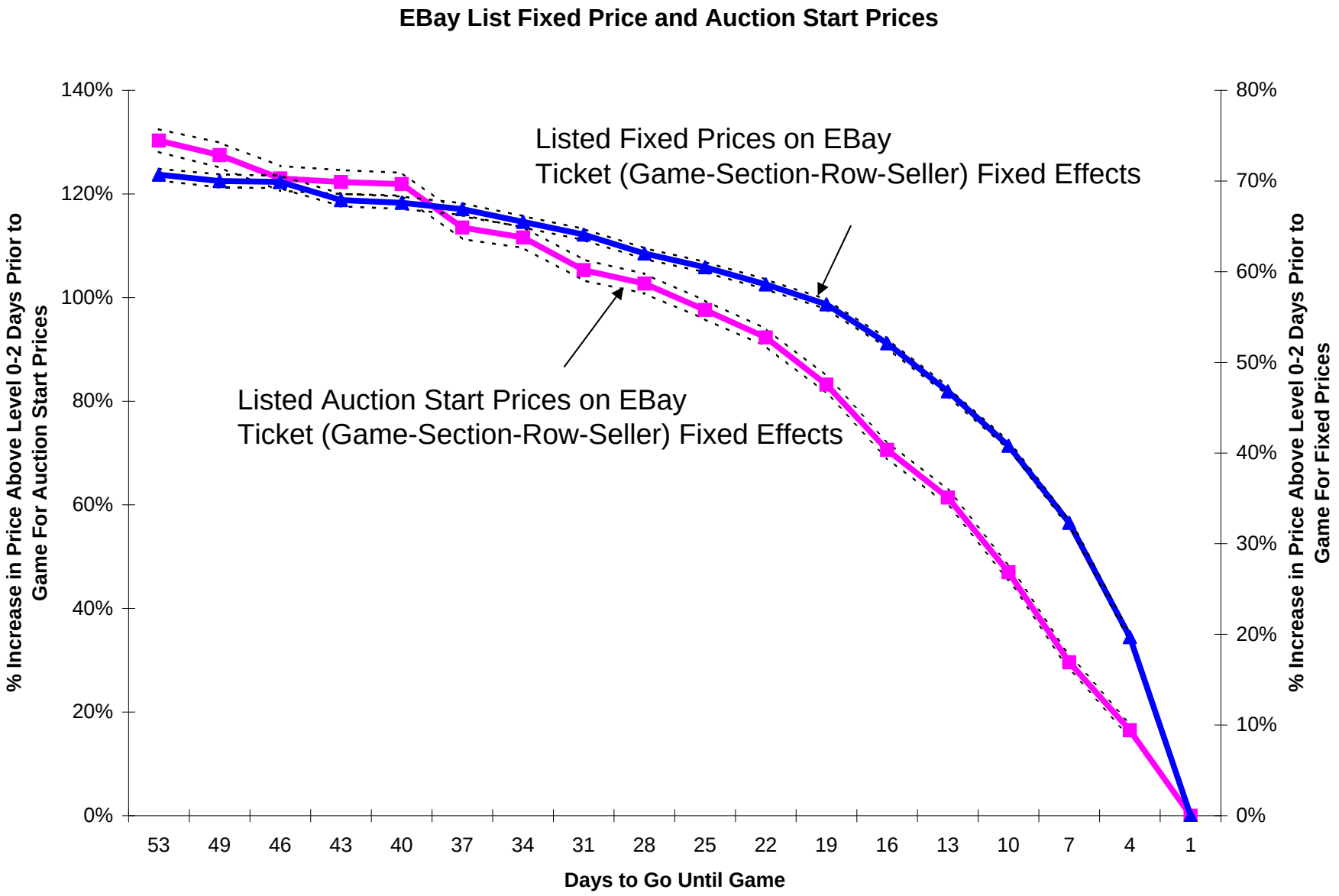
- estimating equation:

$$\begin{aligned}\text{Price or Log(Price)} \quad = \quad & DTG\beta^{DTG} + X^{LIST}\beta^{LIST} \\ & + X^{SLR}\beta^{SLR} + X^{FORM}\beta^{FORM} + FEs + \varepsilon\end{aligned}$$

- measure of price:
  - buyer, seller
  - transaction, list
  - log, levels or relative to face value
- definition of fixed effects, important to control for quality:
  - game-section "Seattle Mariners at New York Yankees on May 6, Loge Box 512" and include row controls; or,
  - game-section-row; or,
  - ticket/seller-game-section


Price Declines in Stubhub List Prices and EBay Transaction Prices
Listed Fixed Prices on Stubhub
Game-Section-Row Fixed Effects
N=3,361,062
Transaction Prices on EBay
Game-Section-Row Fixed Effects
N=300,379
% Increase in Price Above Level 0-2 Days Prior to Game
35%
30%
25%
20%
15%
10%
5%
0%
53
49
46
43
40
37
34
31
28
25
22
19
16
13
10
7
4
1
Days to Go Until Game


EBay List Fixed Price and Auction Start Prices
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
% Increase in Price Above Level 0-2 Days Prior to Game
53
49
46
43
40
37
34
31
28
25
22
19
16
13
10
7
4
1
Days to Go Until Game
Listed Auction Start Prices on EBay
Game-Section Fixed Effects
N=450,425
Listed Fixed Prices on EBay
Game-Section Fixed Effects
N=390,834


EBay List Fixed Price and Auction Start Prices
Listed Fixed Prices on EBay
Ticket (Game-Section-Row-Seller) Fixed Effects
Listed Auction Start Prices on EBay
Ticket (Game-Section-Row-Seller) Fixed Effects
% Increase in Price Above Level 0-2 Days Prior to Game For Auction Start Prices
% Increase in Price Above Level 0-2 Days Prior to Game For Fixed Prices
Days to Go Until Game
140%
120%
100%
80%
60%
40%
20%
0%
80%
70%
60%
50%
40%
30%
20%
10%
0%
53
49
46
43
40
37
34
31
28
25
22
19
16
13
10
7
4
1

Theoretical Explanations for Why Sellers Cut Prices

Explanations 1 and 2: Declining Opportunity Costs and Changing Elasticities

- fixed price listing, two periods, sets price p_t, gets v if unsold after $t = 2$

$$\max_{p_1, p_2} p_1 Q_1(p_1) + p_2 Q_2(p_2)(1 - Q_1(p_1)) + v(1 - Q_2(p_2))(1 - Q_1(p_1))$$

$$\text{FOCs: } Q_1(p_1^*) + \frac{\partial Q_1(p_1^*)}{\partial p_1}[p_1^* - \underbrace{(p_2^* Q_2(p_2^*) + (1 - Q_2(p_2^*))v)}] = 0$$

$$Q_2(p_2^*) + \frac{\partial Q_2(p_2^*)}{\partial p_2}[p_2^* - \underbrace{v}] = 0$$

- opportunity cost of selling is v in period 2, $p_2^* Q_2(p_2^*) + (1 - Q_2(p_2^*))v$ in period 1
- if $Q_1(p_1) \equiv Q_2(p_2)$, $p_1^* > p_2^*$
- explanation 1: prices fall because of declining opportunity costs
- explanation 2: prices fall because of changing demand elasticities

Structural Analysis of Price Setting

Testing the Changing Demand & Declining Opportunity Cost Explanations: Example Fixed Price Listings

- whenever a seller lists a ticket he is solving

$$\max_{p_{st}} p_{st} Q_{st}(p_{st}) + o_{st}(1 - Q_{st}(p_{st}))$$

where Q_{st} is the probability of sale and o_{st} is the opportunity cost of selling. If SOCs satisfied

$$p^*_{st} = o_{st} - \frac{Q_{st}(p_{st})}{\frac{\partial Q_{st}}{\partial p_{st}}}$$

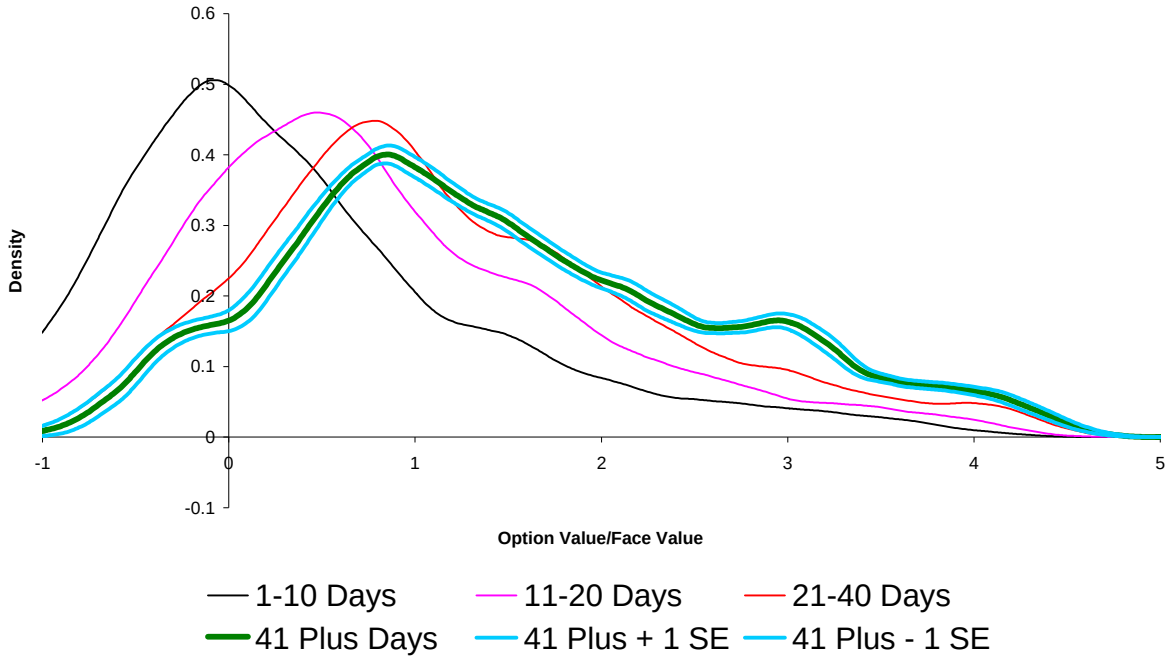
$$\widehat{o_{st}} = p_{st} + \frac{\widehat{Q_{st}(p_{st})}}{\widehat{\frac{\partial Q_{st}}{\partial p_{st}}}}$$

- estimate a parameterized probability of sale function (with varying elasticities)
- instrument (control function) for prices using factors affecting opportunity costs (e.g., seller distance)

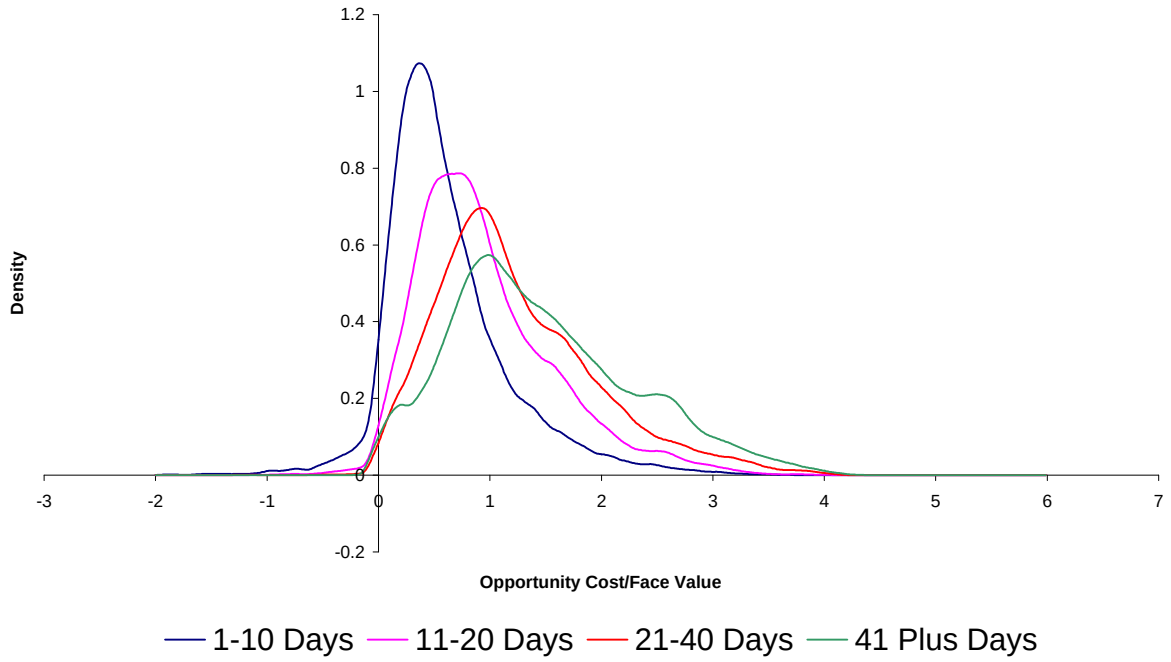
Figure 3

Implied Opportunity Costs
Pure Fixed Price Listings

(a) Relative Price Model



(b) Log Price Model



(a) Counterfactuals for Fixed Price Model
Relative Price Model

	Days Prior to Game			
	1-10	**11-20**	**21-40**	**41 plus**
Actual				
Mean Price	53.58	60.93	65.81	69.44
Median Price	40.63	49.50	54.20	58.50
Counterfactual: demand parameters same as 11-14 days prior to game; competition variables same as average 11-20 days before game				
Mean Price	50.26	59.41	65.66	68.99
Median Price	39.78	49.35	55.13	59.40

(b) Counterfactuals for Fixed Price Model
Log Price Model

	Days Prior to Game			
	1-10	**11-20**	**21-40**	**41 plus**
Actual				
Mean Price	53.58	60.93	65.81	69.44
Median Price	40.63	49.50	54.20	58.50
Counterfactual: demand parameters same as 11-14 days prior to game; competition variables same as average 11-20 days before game				
Mean Price	50.58	58.39	64.33	69.40
Median Price	40.95	49.38	54.95	59.89

Conclusion and Future Research Directions

- robust evidence that prices tend to decline in secondary ticket markets
- strong initial evidence that sellers cut prices because opportunity costs of selling decline as future selling opportunities disappear (because of perishability)
- early buying rational given product differentiation, plausible levels of search costs & risk aversion
- outstanding questions:

1. why are price dynamics different here vs. airline/advertising markets? demand or commitment?
2. what drives the choice between selling mechanisms? auctions may become more dominant because of the value of price flexibility